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Why health insurance should reimburse some cost ineffective services

Results from a pilot survey

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ABSTRACT

Cost ineffective health services – services where the cost-benefit ratio exceeds a normal threshold – are consistent with economic theory when there is a trade-off between equity and efficiency. The trade-off is usually associated with some characteristic of the patient – the geographic, social or demographic circumstances – or some characteristic of the illness – the severity of the resulting health states or its emotional impact upon people. However empirical studies have identified an apparent anomaly: support for cost ineffective services when there appears to be no special circumstances to justify this.

The present paper reports the results of a pilot study which investigates a possible reason for this which arises from self-interested individual motivations when patients are under risk; that is, before the consequences of potential ill health is known. These motivations in the 'pre-outcome' period are omitted from standard risk theory.

A convenience sample of 45 individuals were asked to allocate a budget between the insurance of two types of health care. Choices were compared with the allocation predicted by current theory. Results suggested respondents did not behave as predicted and that some cost ineffective services were preferred to cost effect services.

The significance of the result is three fold. First, it highlights a failure of current theory and, specifically expected utility theory in the present context. Second, it demonstrates that, at least in some cases, the present criteria for the determination of cost effectiveness are inconsistent with people's preferences. Third, and following from this it provides a reason for the provision of some services which, by normal standards would be considered to be 'cost ineffective'.

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1 Introduction

There is a strong argument for public and private health schemes to reimburse some ‘cost ineffective’ services if this is what fully informed members of the schemes want. This paper investigates a possible reason why this might be so.

Prima facie there would appear to be no case for funding services where the benefits of the service to an individual are less than the costs to the individual. If utility is defined by the willingness to pay for a service and personal costs exceed this amount it would appear tautologically false that a rational individual would select the service. This is clear in the theory which describes the optimal allocation of a budget. With two services or products, A and B, the textbook solution which maximises individual’s utility is given in equation 1.

$$\frac{MU_A}{P_A} = \frac{MU_B}{P_B} = \lambda \qquad \text{… equation 1}$$

where MU_i and P_i are the marginal utility and price per unit of the services respectively. If the price is measured in dollars then equation 1 states that the individual will allocate the budget so that the marginal utilities per dollar spent on A and B are equal; otherwise, utility could be increased by transferring spending from the lower to the higher source of utility per dollar. Restated, individuals are predicted to adjust the volume of Service A and Service B until the ratio of MU to price is equal to a threshold λ which may be interpreted as the marginal utility of a dollar. Consequently, equation 1 implies that for both services, $MU_i = \lambda P_i$ or $(MU_i - \lambda P_i) = 0$: services will be purchased until their marginal net benefit, measured in terms of utility is zero. Beyond this point, services would be ‘cost ineffective’ and individuals would not want to buy them.

However when individuals are purchasing insurance against the future costs of ill health they do not know what services they will need. There is an element of risk. Orthodox welfare theory postulates that in these circumstances, the individual will seek to maximise the value of their expected utility. As shown in Box 1 below, this restores the pre-risk conclusion summarised in equation 1. In Expected Utility Theory (EUT) probabilities are importance weights and are independent of realised utilities. Thus, the existence of risk does not alter the conclusion that the final net utility of each acceptable option must be positive (or zero) if the option is to increase (not decrease) expected utility. In the context of health insurance this implies that insured services must all be cost effective.

Box 1 Optimal insurance

The expected utility (EU) from purchasing A and B percent insurance against illnesses A and B is given by equation B1 and the budget constraint by equation B2.

$$EU = p\,U(A) + (1-p)U(B) \qquad \text{… equation B1}$$

$$40 = p[P_A.A] + (1-p)[P_B.B] \qquad \text{… equation B2}$$

where p,(1-p) are the probabilities of illness A and B respectively; and insurance against the illness can be purchased at an actuarially fair price $p.P_A$ and $(1-p)P_B$. To maximise EU, A and B must satisfy equation B3.

$$\frac{d(EU)}{dA} = 0 = p.\left(\frac{\partial U}{\partial A}\right) + (1-p)\frac{\partial U}{\partial B}\cdot\frac{\partial B}{\partial A} \qquad \text{… equation B3}$$

from (B2) $B = \{40 - p[P_A.A]\}/(1-p)P_B$

from which $\dfrac{\partial B}{\partial A} = (-p/(1-p))(P_A/P_B)$

Substituting in (B3) and setting $\dfrac{\partial U}{\partial A} = MU_A, \dfrac{\partial U}{\partial B} = MU_B$

$$0 = p.MU_A - (1-p)MU_B\left(\frac{p}{(1-p)}\right)P_A/P_B$$

$$\frac{MU_A}{P_A} = \frac{MU_B}{P_B} \qquad \text{… equation B4}$$

which is the same as the utility maximising condition under certainty given in equation 1. It may be re-written as equation 4B*, where R is the price ratio P_A/P_B

$$MU_A = R.MU_B \qquad \text{… equation B4*}$$

Equations B5 and B6 give the independently determined marginal utilities after contracting an illness and receiving the care permitted by the insurance purchased.

$$MU_A = a_1 + b_1 A^* \qquad \text{… equation B5}$$

$$MU_B = a_2 + b_2 B^* \qquad \text{… equation B6}$$

where A*, B*, MU_A and MU_B are measured on a 0.00 -1.00 scale and A=100 A*; B = 100 B*

Assuming a probability of 0.5 of contracting both illnesses, the budget constraint, is derived by setting

p = (1-p) = 0.5 in equation B2.

$$80 = P_A.A + P_B.B \qquad \text{…equation B7}$$

Or $A = (80-P_B.B)(1/P_A)$ … equation B8

Substituting B5 and B6 into B4*, and substituting A* = A/100; B* = B/100

$$100\,a_1 + b_1 A = R(100\,a_2 + b_2 B) \qquad \text{… equation B9}$$

Substituting B8 into B9

$$100\,a_1 + b_1(80 - P_B.B)\left(\frac{1}{P_A}\right) = R(100\,a_2 + b_2 B)$$

From which:

$$B = [80b_1 + 100a_1P_A - 100RP_Aa_2]/(b_1P_B + RP_Ab_2)$$

Box 1 cont'd

A note on the budget

With actuarially fair insurance and a probability of contracting an illness of 0.5, the price of a unit of insurance would be 50% of the unit cost of a service. To simplify the questionnaire the relationship between insurance and the services purchased did not relate this information. Rather the budget presented was doubled and the price of the insurance purchased doubled. This had no effect except during the estimation of the optimal insurance in Box 1 above where the 'true' budget of $40,000 was used.

However EUT is known to be descriptively invalid (Schoemaker 1982, Pope, Leitner et al. 2007) and individuals may adopt other decision rules. At the societal level John Rawls (1971) has argued that, for ethical reasons, the maxi-min principle should be adopted and that priority should be given to mitigate the problems of those who are worst off. Individuals may adopt an analogous strategy and, in violation of EUT, have a personal preference for the funding of cost ineffective services when they are the most effective therapies for severe health states. Since the opportunity cost of very expensive procedures – the loss of expected utility elsewhere – cannot be ignored by well informed individuals a more likely observation is that individuals would desire insurance which embodied a compromise between the outcomes predicted by EUT and by other reasonable decision criteria such as the maxi-min principle However with the exception of Nord et al. (2009) there has been little empirical investigation of this hypothesis.

The pilot survey outlined below sought to investigate individuals' choice of insurance under risk, and specifically, to test two hypotheses. The first – expected utility maximisation (EUT) – is that individuals will select 'optimal' insurance consistent with EUT. The second– which is given the label 'maxi-min' – is that relative to EUT, more will be spent on insurance against the worst possible outcome.

2 Methods

Notation and definition are given in Box 2.

Survey respondents were asked to complete two tasks. The first was to allocate a fixed budget between two types of insurance, each of which pays for the treatment of one of two illnesses A and B. The respondents were told to imagine that they were equally likely to contract one of these illnesses. With more insurance more treatment will be obtained if the disease is contracted and the final quality of life will be higher. The visual aid described varying levels of the QoL and respondents were asked to imagine being in a health state before selecting a level of insurance which could result in their being in that health state: that is, expenditure on insurance was linked to the possible health state and QoL to be experienced. The unit prices P_A and P_B (which are also the marginal costs) of insurance were varied to obtain seven budgetary allocations per respondent. The second task was to use a Visual Analogue Scale (VAS) to evaluate the quality of life of the health states which would result from the purchase of 0, 25, 50 and 75 percent insurance against the full cost of treating each disease. VAS scores were transformed into TTO utilities using a functional relationship between the TTO and VAS which was estimated during the construction of the AQoL-8D. (Richardson, Sinha et al. 2014). These health states utilities and full health (1.00) were used to interpolate utility scores for every level of insurance.

For both illnesses, utility was regressed upon the level of insurance. The regressions were used to derive equations for the marginal utility of additional insurance. Utility maximising – 'optimal' – expenditures were estimated using equation 1 in conjunction with a constraint that expenditures on the two forms of insurance must sum to the fixed budget. Marginal cost (MC) was set equal to the unit price of insurance; marginal utility (MU) was obtained from the marginal utility equations described above, and the probability that each illness would occur was set equal to 0.5. The derivation of optimal expenditures is shown in Box 1. Optimal combinations of insurance were calculated from optimal expenditures. This allowed the calculation of the utilities individuals would experience if they contracted each illness when they had optimal insurance. The amounts actually allocated by respondents to the two types of insurance were similarly used to calculate the levels of insurance actually selected. These levels, in turn indicated the QoL and utilities the QoL respondent would experience if they contracted each illness with their chosen level of insurance. In combination with unit marginal costs and data on optimal insurance a database was created which allowed four tests of the hypotheses.

Box 2 Notation, units

Notation	**Definition**	
'optimal'	Behaviour consistent with the utility maximising equation 1	Range
A, B	Percent insurance A, B: selected by respondent	0-100
P_A P_B	Unit price (of 1%) A, B, cost of 100%/100	0.25-2.0
MC_A MC_B	Unit price, P_A, P_B : 7 pairs	0.25-2.0
U_A U_B	(TTO) utility observed by inserting A/100, B/100	U(A): 0.226-1.08
	in regression 7a, 8c	U(B): 0.224-0.996
		0-1.00
MU_A MU_B	Margin utility derived by inserting	MU(A) 0-21-1.35
	A/100, B/100 in eq 7b, 8b	MU(B) 0.04-1.44

Test 1: The first test was a direct test of the optimality condition given by equation 1. I used the results of regression equation 2.

$$\frac{MC_A}{MU_A} = a_1 + b_1 \frac{MC_B}{MU_B} \qquad \text{… equation 2}$$

If a = 0, b = 1 equation 2 satisfies equation 1 for utility maximisation and expected utility maximisation.

In the survey questions the relative price of the two types of insurance was set to induce less spending on illness B so that the worst possible outcome would normally be the result of illness B. The maxi-min hypothesis suggests that, on the margin, individuals will spend a greater amount per unit of utility to mitigate this result, ie $MC_B/MU_B > MC_A/MU_A$, implying $b_1 < 1$ in equation 2. If the 'excess' spending on B (relative to the 'optimal' level of spending) is sufficiently large, spending on A from the depleted budget might fall, increasing MU_A and decreasing MC_A/MU_A as MC_B/MU_B rises. In this case $b_1 < 0$.

Test 2: When the outcome of illness B is potentially worse then the outcome of illness A, a maxi-min strategy would result in greater spending on illness B than would occur under EUT. The 'excess spending' would be expected to rise as U_B falls. Consequently in equation 3, $b_2 < 1$.

$$[Exp(B)]_{obs} / [Exp(B)]_{opt} = a_2 + b_2 (U_B) \qquad \text{… equation 3}$$

where obs, and opt refer to 'observed' and 'optimum' (utility maximising) quantities.

EUT implies that actual will equal optimal expenditures, ie $a_2 = 1$; $b_2 = 0.0$.

Test 3: As P_B/P_A rises, relatively more insurance A will be purchased, the gap between U_A and U_B and therefore the ratio U_A/U_B will rise. However with maxi-min behaviour the gap and the ratio will grow more slowly as people seek to minimise the loss of U_B. Rising P_B/P_A is therefore associated with a fall in the left hand side of equation 4, ie $b_3<0$. The purchase of optimal insurance implies that $a_3 = 1$, $b_3 = 0$.

$$\left[\frac{U_A}{U_B}\right]obs / \left[\frac{U_A}{U_B}\right]opt = a_3 + b_3\left[\frac{P_B}{P_A}\right] \qquad \text{… equation 4}$$

Test 4: As the difference between 'optimal' U_A and U_B increases – $U_A(opt)/U_B(opt)$ rises – the maxi-min hypothesis implies that more resources will be devoted to illness B relative to the optimal level. This will increase observed U_B relative to 'optimal' U_B. In equation 5, b > 0.00.

$$\frac{U_B(obs)}{U_B(opt)} = a + b\frac{U_A(opt)}{U_B(opt)} \qquad \text{… equation 5}$$

Survey

An electronic copy of the questionnaire was administered online to a convenience sample of the general population that had responded to an advertisement seeking participants. The questionnaire is reproduced as Appendix 1. A sub-set of respondents subsequently attended focus groups which had the dual purpose of improving the questionnaire and testing the reliability of answers. At the end of the session participants completed the questionnaire a second time. Differences were recorded.

In the questionnaire an artificial scenario was described (to survey respondents). With some abbreviation this was as follows:

> Imagine that the Government has scrapped Medicare … You have been given a voucher for $80,000 and you may use this to buy insurance cover against particular illnesses… Each level of insurance guarantees you a particular level of cure and guarantees you a particular quality of life if you contract the illness… For simplicity we are going to deal with only two illnesses… Please imagine that in the near future you will definitely have either illness A or illness B but you do not know which illness it will be… We will ask you to show how much insurance you would buy against each illness.

The first question is summarised in Box 3 which, after explanation, was the visual aid used for the questions. The two scales in Box 3 represent the levels of insurance cover and the cost of the insurance which might be purchased against the two illnesses, labelled 'physical' and 'mental'. To the right of the scale is the guaranteed health state, which is described using the EQ-5D-5L levels. In question 1 the cost of full insurance cover against both illnesses is $50,000 + $50,000 = $100,000. As the budget is $80,000 respondents were forced to choose the mix of insurance which met the budget.

Seven similar questions were asked. Each replicated Box 3 but with a change in the cost of insurance. Questions 2-5 did not vary the cost of insurance against illness A. The cost of full insurance against illness B was increased by 50, 100, 200 and 300 percent. Questions 6 and 7 reduced the cost of insurance against illness A by 20 and 50 percent while full coverage against illness B was $100,000.

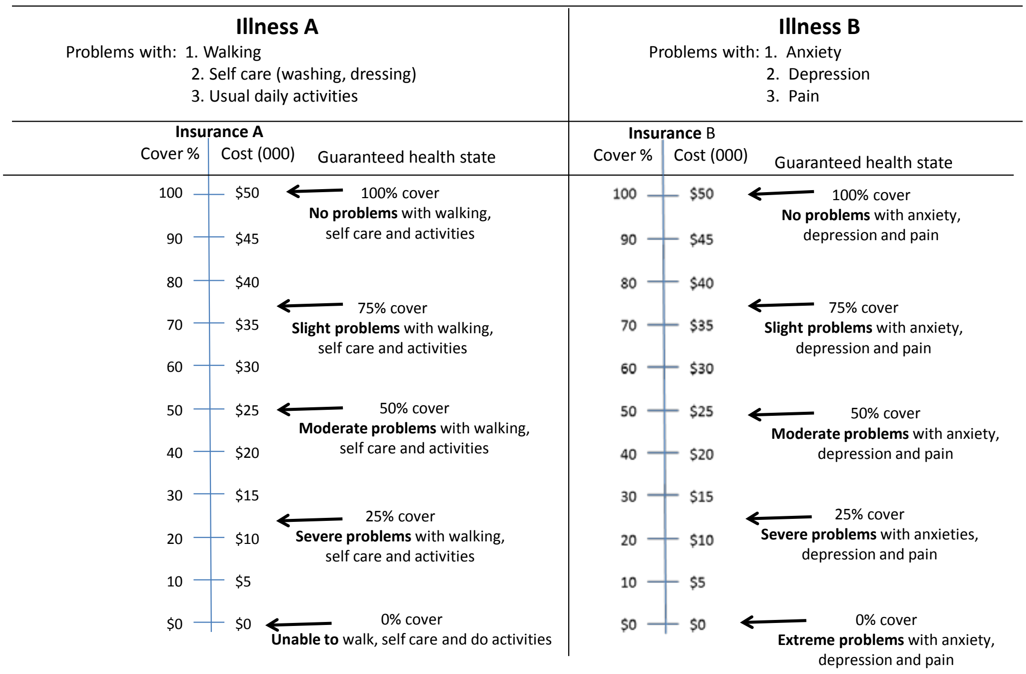
Upon completing the seven questions, respondents were asked to rate the 8 EQ-5D-5L poor health states on the VAS reproduced in Appendix 2. Appendix 2 also reproduces survey question 8 and question 9 which include the health states presented to respondents. Values from the VAS were transformed using the equation 1 $(1\text{-TTO}) = (1\text{-VAS})^{1.62}$: n = 188, $R^2 = 0.94$. Data for this equation were the average VAS and TTO scores obtained for AQoL-8D dimensions and used in the construction of the AQoL-8D utility algorithm (Richardson, Sinha et al. 2014). The effect of the transformation is illustrated in the following two lines.

VAS	:	1.0	0.80	0.60	0.40	0.20	0.10	0.0
$\text{TTO} = 1-(1-\text{VAS})^{1.62}$	:	1.0	0.93	0.77	0.56	0.30	0.16	0.0

Utilities obtained for the four health states associated with each illness were used to interpolate utility scores for each level of insurance. For example, the second highest health state ('slight problems') is shown to correspond with 75 percent insurance. If this health state was assigned a utility of 0.9 then each percentage point increase in insurance above 75 percent was assigned an incremental utility of 0.1/25. Similarly, the utilities resulting from other levels of insurance were interpolated from the respondents VAS/TTO scores for the health states corresponding with 25, 50 and 75 percent insurance.

Box 3 Visual aid for question 1

Question 1
Think about your life in the health states described on the 2 scales.
Illness A affects walking, dressing and your usual activities. Other parts of your health have no problem. The cost of a complete cure is $50,000.
Illness B causes mental health and problems and pain. The cost of insurance guaranteeing a full cure is also $50,000.
Please write the amounts you would spend on insurance against illness A and illness B. Please ensure that the two amounts you enter add up to $80,000.



Your spending on Insurance A $................ Plus your spending on Insurance B $.................. = $80,000

3 Results

The pilot survey was completed by 45 individuals, 20 of whom attended subsequent focus groups and were able to adjust their answers. Table 1 reports their personal characteristics. Table 2 gives the average VAS scores and TTO utilities for the health states resulting from the insurance purchased at different unit prices. Regression of utilities upon insurance resulted in equations 7a and 7b which were used to derive equations 8a and 8b for the marginal utility of expenditures upon insurance A and B respectively.

Table 1 Respondent characteristics

	Gender		Education			Total
Age	**Male**	**Female**	**High school**	**Dip/trade**	**Uni**	
18-24	6	8	7		7	14
25-44	9	9	1	1	16	18
45-64	4	8	3	3	6	12
65+	1			1		1
Total	20	25	11	5	29	45

Table 2 VAS and TTO utilities

	Health State 1: 'Physical'				Health State 2: 'Mental'			
	VAS		**TTO**		**VAS**		**TTO**	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Slight	0.8264	0.1003	0.9319	0.0635	0.8204	0.1096	0.9271	0.0745
Moderate	0.6113	0.1006	0.7765	0.0911	0.6238	0.1249	0.7837	0.1157
Severe	0.3411	0.1073	0.4846	0.1318	0.384	0.1386	0.5323	0.1628
Extreme	0.1644	0.0939	0.2478	0.1328	0.1378	0.084	0.2098	0.1201

Utility

$$U_A = 0.226 + 1.351A - 0.569A^2$$

$$R^2 = 0.85; n = 333 \qquad \text{… equation 7a}$$

$$U_B = 0.244 + 1.442B - 0.697B^2$$

$$R^2 = 0.84; n = 333 \qquad \text{… equation 8a}$$

Marginal utility

$$MU(A) = 1.351 - 1.138A \qquad \text{… equation 7b}$$

$$MU(B) = 1.442 - 1.394A \qquad \text{… equation 8b}$$

Table 3 presents the summary of respondents' insurance decisions. These were similar across respondents resulting in relatively small standard deviations around the mean values. As the relative price of B increases the purchase of both A and B decline (an 'income effect') but the decrease in A from 85 to 55 percent is significantly less than the decrease in B from 75 to 26 percent, owing to a significant substitution effect as relative prices change.

Table 3 Insurance selected

	Unit Cost (MC)		% Insurance (Ins)		Standard deviation		Mean Utility observed				Marginal utility MU		Ratio MC/MU		Expenditure Observed unit cost x ins $		Ratio
	P_A	P_B	A	B	A	B	A U(A)	B U(B)	Average	Differences	A	B	A	B	exp A	exp B	exp B/exp A
1	0.50	0.50	85.00	75.00	10.14	10.14	0.93	0.94	0.94	-0.01	0.38	0.40	1.30	1.26	42.50	37.50	0.88
2	0.50	0.75	77.50	55.00	12.87	8.58	0.86	0.87	0.86	-0.01	0.47	0.68	1.07	1.11	38.75	41.25	1.06
3	0.50	1.00	70.00	45.00	13.72	6.86	0.82	0.79	0.80	0.02	0.55	0.81	0.90	1.23	35.00	45.00	1.29
4	0.50	1.50	65.00	31.67	19.76	6.59	0.75	0.67	0.71	0.08	0.61	1.00	0.82	1.50	32.50	47.50	1.46
5	0.50	2.00	55.00	26.25	24.11	6.04	0.70	0.59	0.65	0.11	0.72	1.08	0.69	1.86	27.50	52.50	1.91
6	0.40	1.00	75.00	50.00	19.54	7.82	0.87	0.80	0.84	0.07	0.50	0.75	0.80	1.34	30.00	50.00	1.67
7	0.25	1.00	80.00	60.00	16.07	4.22	0.94	0.85	0.89	0.08	0.44	0.61	0.57	1.65	20.00	60.00	3.00

Table 4 'Optimal Insurance' P_A/P_B

	Unit Cost (MC)		% Insurance Optimal		Mean Utility						MU		Ratio MC/MU		Expenditure optimal unit cost instrument $		Ratio exp B/exp A
	P_A	P_B	A	B	U(A)	U(B)	U_B	U_A/U_B	Ave	Differ-ences	A	B	A	B	A	B	
1	0.50	0.50	84.49	75.51	0.96	0.94	0.94	1.0	0.95	0.03	0.39	0.39	1.28	1.28	42.25	37.75	0.89
2	0.50	0.75	78.57	54.28	0.94	0.82	0.87	1.14	0.88	0.11	0.46	0.69	1.09	1.09	39.29	40.71	1.04
3	0.50	1.00	79.89	40.05	0.94	0.71	0.79	1.32	0.83	0.23	0.44	0.88	1.13	1.13	39.95	40.05	1.00
4	0.50	1.50	86.49	24.50	0.97	0.56	0.67	1.73	0.76	0.41	0.37	1.10	1.36	1.36	43.24	36.76	0.85
5	0.50	2.00	92.23	16.94	0.99	0.47	0.59	2.10	0.73	0.52	0.30	1.21	1.66	1.66	46.11	33.89	0.73
6	0.40	1.00	89.66	44.14	0.98	0.74	0.80	1.32	0.86	0.24	0.33	0.83	1.21	1.21	35.86	44.14	1.23
7	0.25	1.00	103.61	54.10	1.01	0.82	0.85	1.23	0.92	0.19	0.17	0.69	1.45	1.45	25.90	54.10	

Results from the estimation of optimal insurance, as described in Box 1, are reported in Table 4. In comparison with Table 3 – the insurance actually purchased – substitution effects are significantly greater, with insurance against B dropping to a minimum of 16.9 percent while the insurance against A initially falls but subsequently rises to 103 percent – 20 percentage points higher than its initial level despite the income effect. Expected utility, the average of the utilities after the purchase of A and B, is consistently greater for the optimal insurance reported in Table 4 than the actual expected utility resulting from respondents' choices.

The maximum difference between U_A and U_B with optimal insurance is 0.52, 4.7 times greater than the maximum difference of 0.11 with selected insurance.

Figure 1 plots the average insurance selected and the 'optimal' insurance with the price of A unchanging at 0.5 and the price of B rising from 0.5 to 2.0. In both cases there is a substitution of A for B. However with the selected insurance the substitution is relatively small. In contrast, with optimal insurance the substitution is so great that the purchase of A rises to be 45 percentage points above actual purchases. This pattern is also evident in Figure 2 which plots observed and optimal utility.

Figure 1 'Optimal' and selected insurance mean data

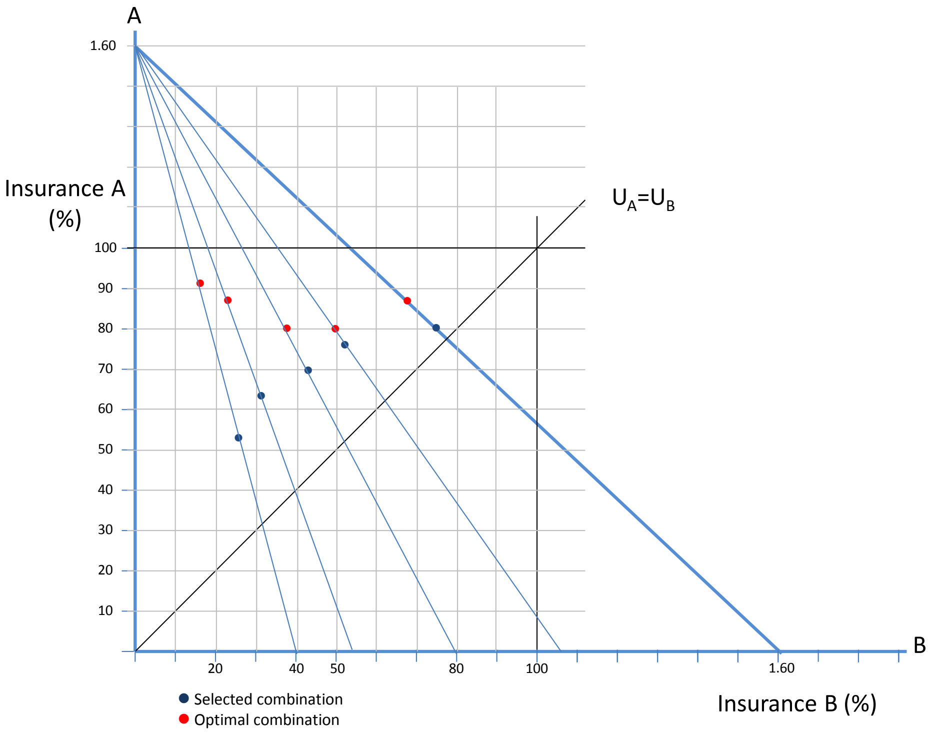
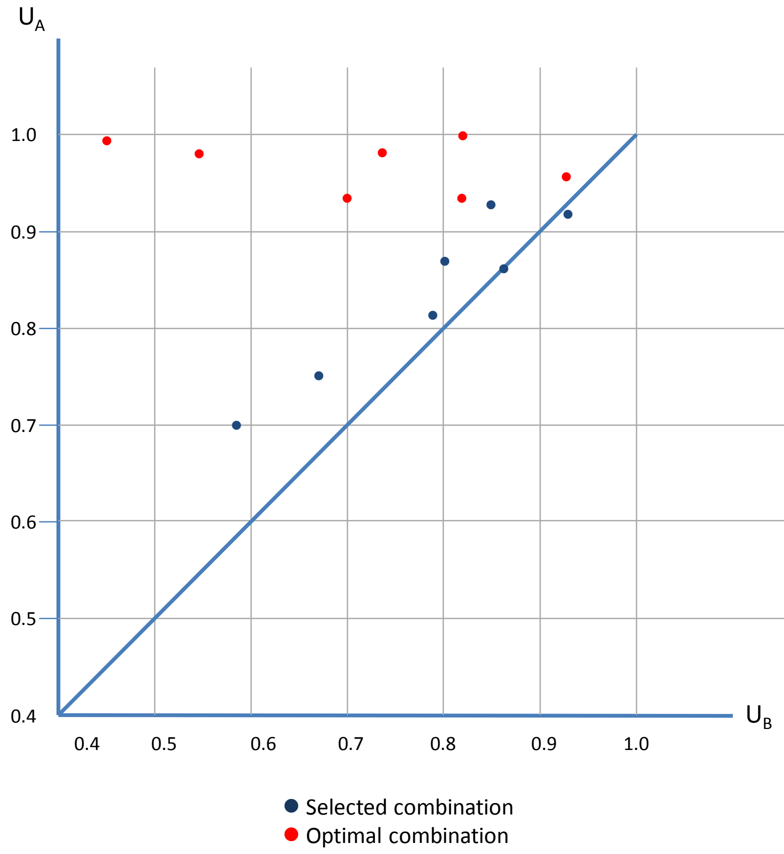


Figure 2 U_A, U_B, optimal and observed



Test 1: To test whether data are consistent with the optimality condition, equation 2, equation 2a was estimated using 311 individual observations. Average data are plotted in Figure 3.

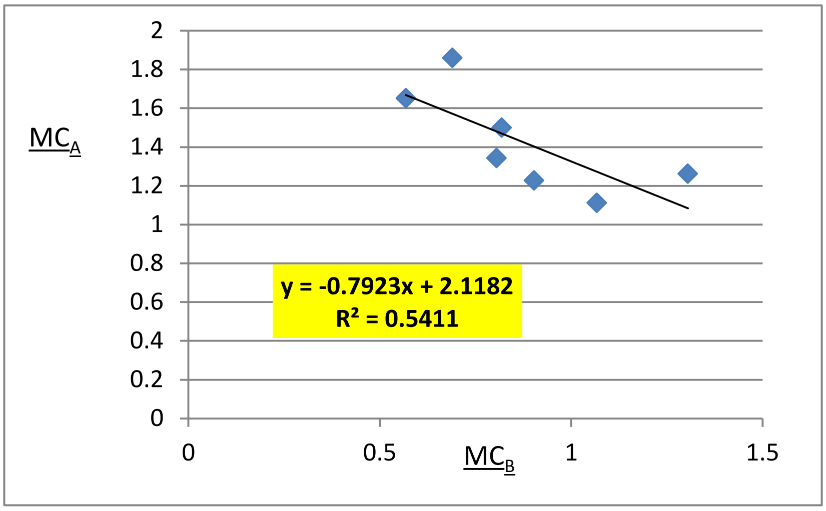
$$\frac{MC_A}{MU_A} = 2.0 - 0.70\left(\frac{MC_B}{MU_B}\right) \qquad \text{… equation 2a}$$

t = -10.8 = R^2 = 0.27 n = 311

The EUT hypothesis that b=1 may be rejected at the 1.0 percent level. In contrast the t statistic of -10.8 supports at the 1 percent level the maxi-min hypotheses that b<1.00.

The EUT hypothesis that b=1 may be rejected at the 1.0 percent level. In contrast the t statistic of -10.8 supports at the 1 percent level the maxi-min hypotheses that b<1.00.

Figure 3 Results from Test 1 (mean data)



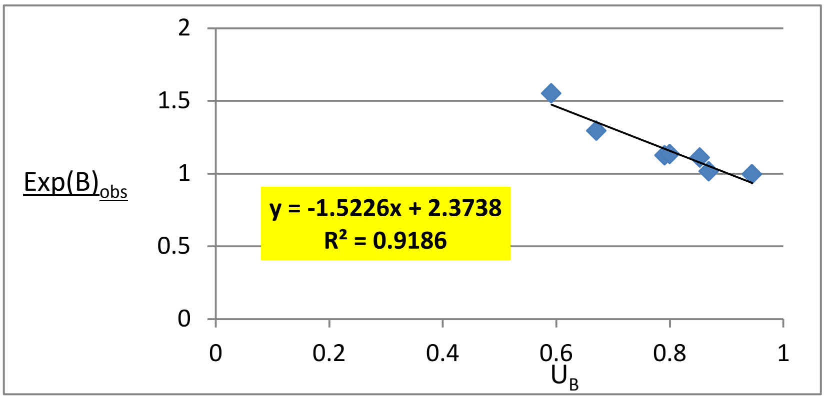
Test 2: The second test of the maxi-min hypothesis was that the ratio of actual to 'optimal' expenditures on insurance B would rise as the utility of the worst outcome B fell (equation 3). The ratio is compared in Figure 4 using average data and equation 3a was estimated with individual data.

$$(ExpB)/(ExpB)_{opt} = 1.91 - 0.82\,U_B \qquad \text{… equation 3a}$$

$$t = 6.11;\ R^2 = 0.12;\ n = 286$$

The statistically significant negative coefficient is consistent with the maxi-min but not the EUT hypothesis.

Figure 4 Results from Test 2 (Mean data)



Test 3: As P_A/P_B falls, the ratio U_A/U_B rises. The third test was to determine whether the increase in U_A/U_B was less with selected, than with 'optimal', insurance (equation 4). Average data for the

test are plotted in Figure 5 and regression equation 4a was estimated using individual data. The significant negative coefficient on P_A/P_B is consistent with the maxi-min hypothesis and conflicts with EUT.

$$\left[\frac{U_A}{U_B}\right] obs / \left[\frac{U_A}{U_B}\right] opt = 1.09 - 0.13 \left[\frac{P_A}{P_B}\right] \qquad \text{… equation 4a}$$

t = -13.25; R^2 = 0.36; n = 311

Test 4: As the gap between optimal U_A and U_B and the ratio of U_A(opt)/U_B(opt) increase– U_B(obs)/U_B(opt) rises. Average data for this test are plotted in Figure 6 and the regression using individual data is reported in equation 5a.

$$\frac{U_B(obs)}{U_B(opt)} = 0.78 + 0.23 \frac{U_A(opt)}{U_B(opt)} \qquad \text{… equation 5a}$$

t = 16.3 R^2 = 0.46; n=311

Results again favour the maxi-min over the EUT hypothesis.

Figure 5 Results form Test 3 (mean data)

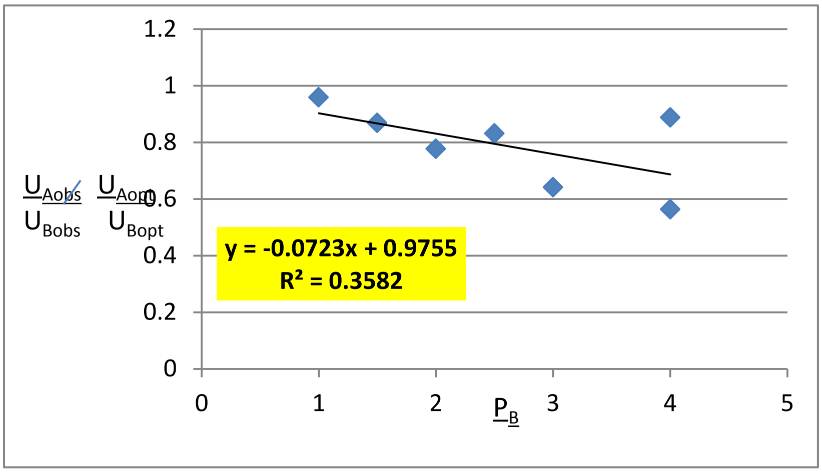
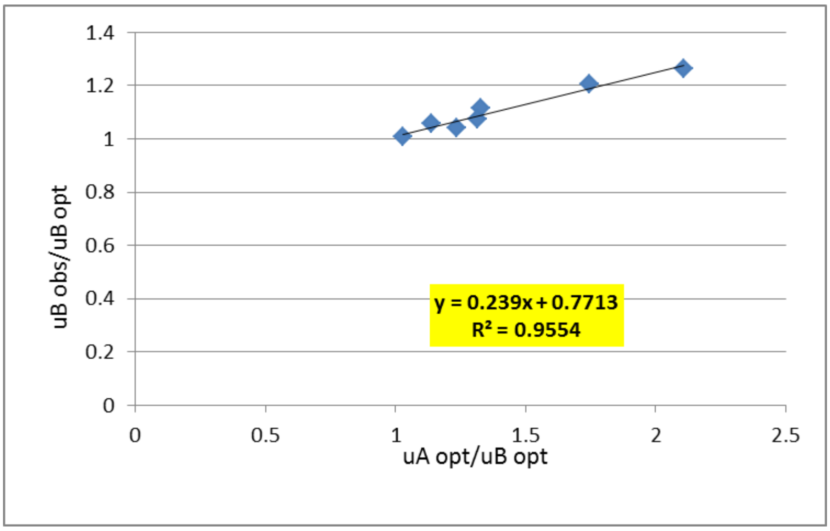


Figure 6 Results from Test 4 (mean data)



4 Discussion

The theoretical literature has always allowed a trade-off between equity and efficiency when the latter concept, efficiency, is only defined by cost and individual preferences. Equity is hard to operationalise and is culture-specific. For example, in Australia, the Pharmaceutical Benefits Advisory Committee (PBAC) which is responsible for the assessment of drugs, accepts that ‘cost ineffective’ drugs may be funded because of the Rule of Rescue (McKie and Richardson 2003, Littlejohns and Rawlins 2009p. 118). In their guidelines this is described by three characteristics viz, (i) that no alternative treatment exists; (ii) that the relevant condition is severe, progressive and expected to lead to premature death; and (iii) that the condition applies to a very small number of patients (Cookson, McCabe et al. 2007).

These criteria define circumstances which are similar to those considered in the present paper. However there are several significant differences. The Rule of Rescue arises from ethical arguments: it falls into the broad category of a fairness or equity based criterion. The present paper has been concerned with well informed individual choices. Consequently the arguments relate to efficiency, not equity. Secondly, while the Rule of Rescue – or at least the Australian version of it – is limited to rare and generally terminal conditions, the present article is concerned with a broader category of conditions: those which are severe but where effective treatment is cost ineffective because of its cost. Because of the assumption of expected utility theory severity per se does not alter the usual evaluative criteria. For expected utility to increase there must be an increase in net realised utility for each possible outcome: risk per se does not alter this conclusion. Consequently, ‘optimal’ insurance will only cover services which are cost effective.

In principle, the observation that people will pay for a particular type or level of insurance protection is consistent with broad welfare theory (excluding EUT) if ‘benefit’ is defined by the individual’s ex ante willingness to pay for the protection. However the theory of economic evaluation does not adopt this definition. ‘Benefit’ is defined by realised consequences for the length and quality of life. These may be valued using willingness to pay techniques. However, irrespective of the valuation technique the benefits associated with consequences are a subset of the total benefits which an individual considers in the purchase of insurance. Benefits in the pre-outcome period are excluded. Choice, however, may be affected, *inter alia*, by fear, hope and anxiety. As suggested by Loomes and Sugden (1982) people may be motivated by anticipated regret. These considerations in the pre-outcome period might result in preferences and behavioural changes which have an important effect upon an individuals' choices and utility (Pope and Selten 2010).

The experimental results presented here suggest that these changes may be quantitatively significant. From Tables 3 and 4 the largest discrepancy between chosen and optimal insurance – 9.4 percentage points – represents a 55.6 percent increase above the level of optimal insurance. It is associated with a 55 percent increase in spending on B and a 41 percentage point decrease in the discrepancy between U_A and U_B. In selecting this outcome respondents have implicitly rejected decision making on the basis of expost marginal cost to utility ratios. Their choices result in a higher MC/MU ratio for B than for A – 1.86 versus 0.69 – implying the possibility of increased expost utility if low cost U(A) was substituted for high cost U(B).

While these results are consistent with broad welfare theory their translation into an applied evaluation methodology is problematical. The experimental design assumed that the levels of treatment or services for illnesses were variable and the study question related to the level of servicing. In contrast, CUA typically focuses upon the costs and benefits of a single service. However with a wider focus the endpoint of economic evaluation is not the net worth of a service per se but the level of servicing which is appropriate for a patient. Commonly there are multiple levels of possible servicing ranging from minimal palliative care through to best, state of the art interventions. CUA is intended to indicate the appropriate choice from these options. The present study is clearly limited to cases where present evaluative methods do not endorse the technically best option but, because of cost, imply a less effective therapy for a patient. The results of the study reported here imply that the total utility obtained from the more effective option (including the pre and post-outcome periods) may be significantly underestimated by present expost evaluation methods and that the reassessment of benefits may result in their adoption as the preferred therapy.

Notwithstanding measurement problems the present results suggest there is an omission in present methods and that well informed individuals would include 'cost ineffective' services in their insurance when these services give protecting against worst case outcomes. The challenge this raises for evaluation could be avoided if the objective of an insurance scheme was defined as the maximisation of realised health, and not the provision of the services which well informed policy holders would select. As most policy holders are very unlikely to be aware of the severity of the full range of possible outcomes, their probability of contracting the illness or even what their insurance scheme included or excluded, the problem raised here could be sidelined: there can be no demand for services when people are unaware of their potential need for the services. The normative question of whether insurance and the allocation of resources should reflect the wishes of a hypothetically well informed public, or seek an imposed goal of health maximisation is outside the scope of this article.

In its present form there are numerous caveats to the study, largely arising from the complexity of the cognitive task given to survey respondents. In addition to imagining counterfactual cancellation of all other forms of insurance, individuals were asked to trade-off insurance protection against abstract and somewhat vague health states. These may be defended as being derived from the EQ-5D-5L, but the EQ-5D-5L is not immune from criticism. Some survey respondents had difficulty understanding the VAS evaluation task. The use of the VAS may also be defended in terms of its widespread usage, but results depended upon the validity of the difference between VAS assessments and this again compounds the effects of an imprecise understanding of the task.

While measurement error is unavoidable the survey was designed to be insensitive to relatively large random error. Health states varied across the full range permitted by the EQ-5D-5L and the price of insurance was varied by up to 300 percent. In the event, the sub-sample of respondents who were included in group discussions made few changes to their initial answers and mean scores on every question were virtually identical in the two groups. This suggests that online respondents are capable of completing relatively difficult tasks if they are introduced and explained appropriately.

A second major caveat is that the sample of 45 was small and non-representative. While the study needs to be repeated with a larger sample, the consistency of the results strongly suggests that a larger and more representative survey will lead to similar conclusions.

5 Conclusions

Because of the dominating role of expected utility theory in welfare theoretic analyses little attention has been given to the possibility that individuals may have a preference for the inclusion of ‘cost ineffective’ services in their personal insurance. However it is plausible that under risk or, more correctly, uncertainty (as individuals do not know the probabilities of different outcomes) people will seek greater than ‘optimal’ protection for worst case outcomes. EUT disregards emotions, preferences and behaviours in the pre-outcome period, EUT and cannot therefore take account of choices based upon them. This implies that current theory and evaluation methods may recommend against the inclusion of services in the health scheme which individuals might wish to include. The survey results indicate that the discrepancy between the total benefits revealed by a well informed public and those assessed using present evaluative methods may be quantitatively large. As a consequence less effective therapies may be selected for some severe problems by health authorities. This implies that some services which are currently deemed to be ‘cost ineffective’ should be reconsidered for inclusion in the health service if they are effective therapies for severe health problems.

Appendix 1 The Questionnaire

High Cost Treatment questionnaire

Thanks for participating in the survey.

This survey is part of a research program at the Centre for Health Economics at Monash University and is not connected with any political or commercial interest.

The questions we'll ask you are a pilot study for a larger research project which concerns the allocation of Medicare's budget. The questions do not deal directly with Medicare. They are artificial and designed to help us understand people's preferences for insurance.

There are only 8 questions. However it is important that you think carefully about them.

Please read the 'INTRODUCTION TO THE QUESTIONS' very carefully: re-read them if necessary to ensure you understand the task before answering the questions.

Thank you for your careful assistance. Your answers will help us understand the sort of services people would like Medicare to insure.

Prof Jeff Richardson
Foundation Director
Centre for Health Economics
Monash University

Introduction to the questions

Please imagine that the government has scrapped Medicare and replaced it with a scheme which gives people a voucher.

Imagine you have been given a voucher for $80,000 and you may use this to buy insurance cover against 2 illnesses. Imagine that you cannot add to this amount with your own income.

If you spend a lot on insurance against one illness you will receive more services if you need them but have less money left over to buy insurance against the other illness.

For simplicity imagine that each level of insurance you can buy will guarantee a particular level of cure and guarantee you a particular quality of life if you get the illness. The guaranteed level rises with the amount of insurance you buy.

In the questions below we'll call the 2 illnesses: Illness A and Illness B. Please imagine that **in the near future you will definitely have either Illness A or Illness B. But you do not know which illness it will be.**

The problem is that the cost of complete insurance for both illnesses is greater than $80,000. You must decide how much insurance to buy to protect yourself against the costs of treating illness A and illness B.

The next few pages explain the question.

Illness A

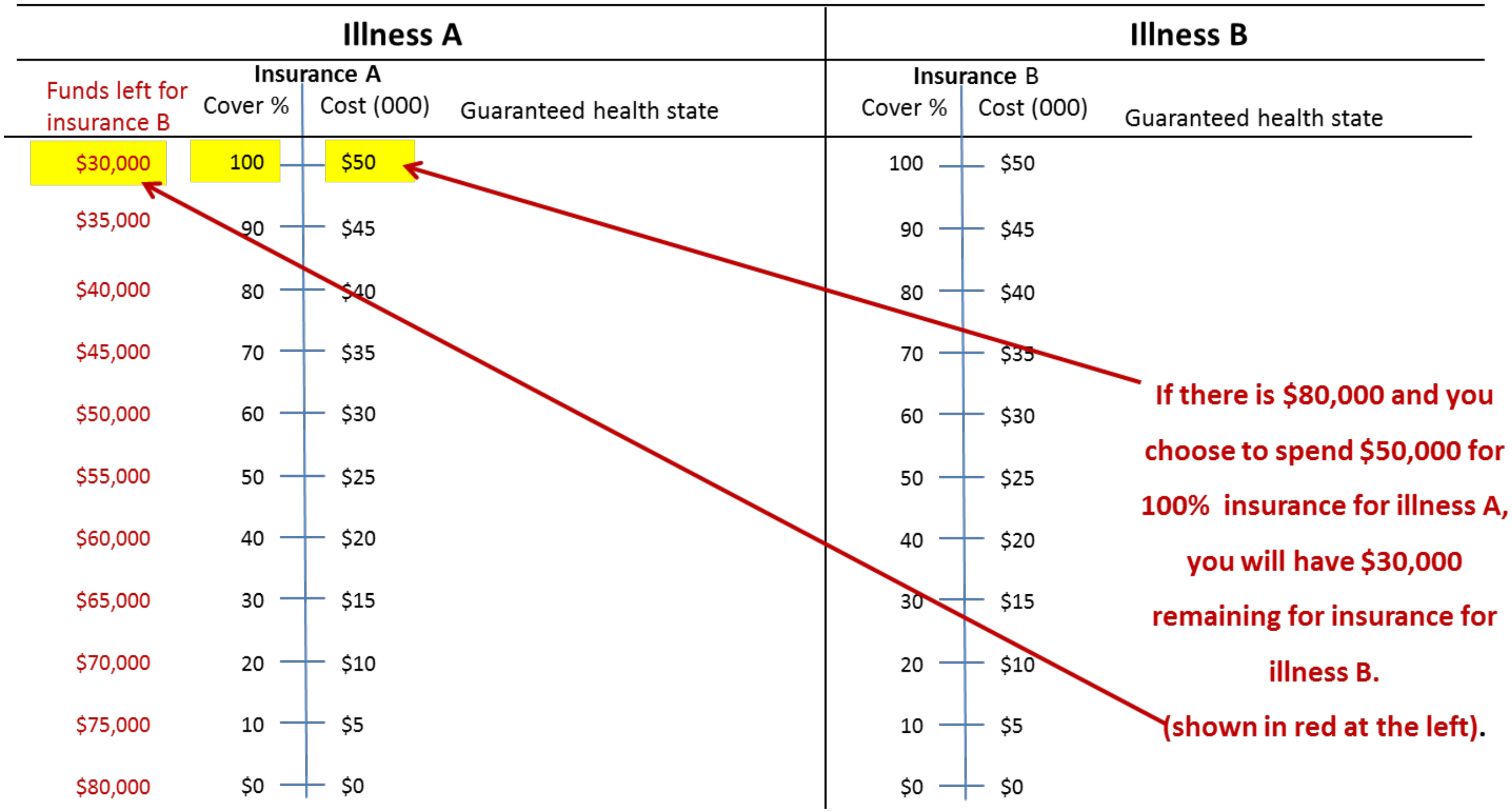
Insurance A

Cover %	Cost (000)
100	$50
90	$45
80	$40
70	$35
60	$30
50	$25
40	$20
30	$15
20	$10
10	$5
$0	$0

Guaranteed health state *(to be described)*

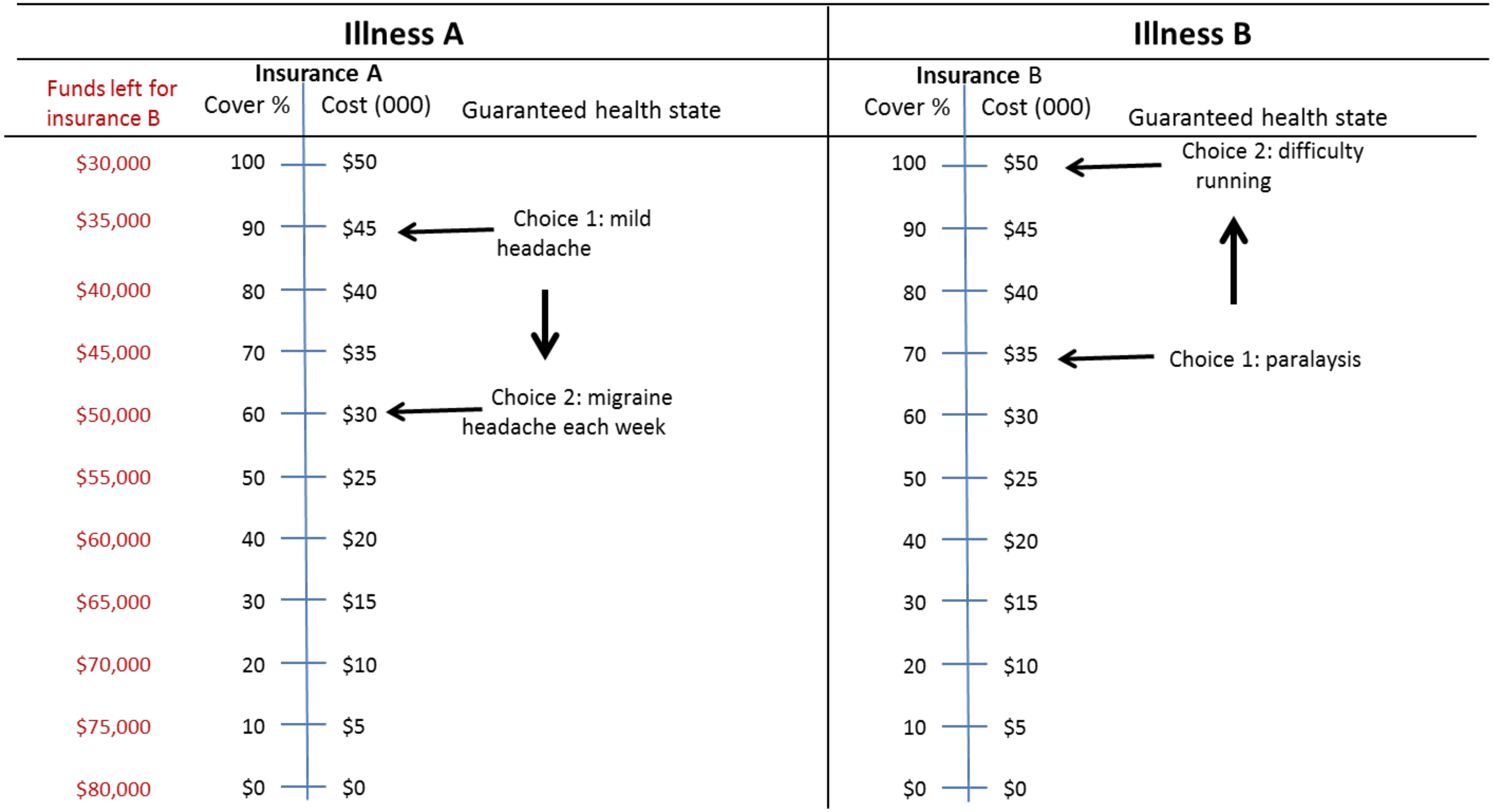
The scale at the left shows how much insurance for illness A will cost with the corresponding % of insurance cover.

There will be various guaranteed health states achieved with whichever cover is chosen.


Illness A
Illness B
Funds left for insurance B
Insurance A
Cover %
Cost (000)
Guaranteed health state
Insurance B
Cover %
Cost (000)
Guaranteed health state
$30,000
$35,000
$40,000
$45,000
$50,000
$55,000
$60,000
$65,000
$70,000
$75,000
$80,000
100 $50
90 $45
80 $40
70 $35
60 $30
50 $25
40 $20
30 $15
20 $10
10 $5
$0 $0
If there is $80,000 and you choose to spend $50,000 for 100% insurance for illness A, you will have $30,000 remaining for insurance for illness B.
(shown in red at the left).

For Example: You may consider choice 1: spending $45,000 on insurance A and $35,000 on insurance B. You must check what this means for your health in the column marked ‘Guaranteed health state’. Your insurance would leave you with a mild headache if you got illness A and leave you paralysed if you got illness B.

Thinking about this, you would probably decide to change your mind and buy more insurance B and less insurance A. You might think choice 2 is a better split: the maximum $50,000 for B and $30,000 for A, i.e. more cover against illness B and less cover against illness A. The change means that you would have a migraine each week if you got illness A but only difficulty running if you got illness B.



Question 1: The health states are now described a little more fully. Think about your life in the guaranteed health states described in the 2 scales as you choose your insurance cover.

Illness A affects walking, dressing and your usual activities. Other parts of your health have no problem. The cost of a complete cure is $50,000.

Illness B causes mental health and problems and pain. The cost of insurance guaranteeing a full cure is also $50,000.

In the highlighted boxes, write the amounts you would spend on insurance against illness A and illness B. Please ensure that the two amounts you enter add up to $80,000.

Illness A

Problems with: 1. Walking; 2. Self care (washing, dressing); 3. Usual daily activities

Funds left for insurance B	Insurance A Cover %	Insurance A Cost (000)	Guaranteed health state
$30,000	100	$50	100% cover **No problems** with walking, self care and activities
$35,000	90	$45	
$40,000	80	$40	
$45,000	70	$35	75% cover **Slight problems** with walking, self care and activities
$50,000	60	$30	
$55,000	50	$25	50% cover **Moderate problems** with walking, self care and activities
$60,000	40	$20	
$65,000	30	$15	
$70,000	20	$10	25% cover **Severe problems** with walking, self care and activities
$75,000	10	$5	
$80,000	$0	$0	0% cover **Unable to** walk, self care and do activities

Illness B

Problems with: 1. Anxiety; 2. Depression; 3. Pain

Insurance B Cover %	Insurance B Cost (000)	Guaranteed health state
100	$50	100% cover **No problems** with anxiety, depression and pain
90	$45	
80	$40	
70	$35	75% cover **Slight problems** with anxiety, depression and pain
60	$30	
50	$25	50% cover **Moderate problems** with anxiety, depression and pain
40	$20	
30	$15	
20	$10	25% cover **Severe problems** with anxieties, depression and pain
10	$5	
$0	$0	0% cover **Extreme problems** with anxiety, depression and pain

Check the guaranteed health states you have selected. Be sure there is no better mix of insurance.

Question 2:

The cost of a complete cure for illness A remains at $50,000. The cost of insurance guaranteeing a full cure for illness B is **now changed to $75,000.**

In the highlighted boxes, write the amounts you would spend on insurance against illness A and illness B. Please ensure that the two amounts you enter add up to $80,000.

Illness A

Problems with: 1. Walking
2. Self care (washing, dressing)
3. Usual daily activities

Funds left for insurance B	Insurance A Cover %	Insurance A Cost (000)	Guaranteed health state
$30,000	100	$50	← 100% cover **No problems** with walking, self care and activities
$35,000	90	$45	
$40,000	80	$40	
$45,000	70	$35	← 75% cover **Slight problems** with walking, self care and activities
$50,000	60	$30	
$55,000	50	$25	← 50% cover **Moderate problems** with walking, self care and activities
$60,000	40	$20	
$65,000	30	$15	
$70,000	20	$10	← 25% cover **Severe problems** with walking, self care and activities
$75,000	10	$5	
$80,000	$0	$0	← 0% cover **Unable to** walk, self care and do activities

Illness B

Problems with: 1. Anxiety
2. Depression
3. Pain

Insurance B Cover %	Insurance B Cost (000)	Guaranteed health state
100	$75	← 100% cover **No problems** with anxiety, depression and pain
90	$67.5	
80	$60	
75	$52.5	← 75% cover **Slight problems** with anxiety, depression and pain
60	$45	
50	$37.5	← 50% cover **Moderate problems** with anxiety, depression and pain
40	$30	
30	$22.5	
20	$15	← 25% cover **Severe problems** with anxieties, depression and pain
10	$7.5	
$0	$0	← 0% cover **Extreme problems** with anxiety, depression and pain

Question 3:

The cost of a complete cure for illness A remains at $50,000. The cost of insurance guaranteeing a full cure for illness B is **now changed to $100,000.**

In the highlighted boxes, write the amounts you would spend on insurance against illness A and illness B. Please ensure that the two amounts you enter add up to $80,000.

Illness A

Problems with: 1. Walking
2. Self care (washing, dressing)
3. Usual daily activities

Funds left for insurance B	Insurance A Cover %	Insurance A Cost (000)	Guaranteed health state
$30,000	100	$50	100% cover **No problems** with walking, self care and activities
$35,000	90	$45	
$40,000	80	$40	
$45,000	70	$35	75% cover **Slight problems** with walking, self care and activities
$50,000	60	$30	
$55,000	50	$25	50% cover **Moderate problems** with walking, self care and activities
$60,000	40	$20	
$65,000	30	$15	
$70,000	20	$10	25% cover **Severe problems** with walking, self care and activities
$75,000	10	$5	
$80,000	$0	$0	0% cover **Unable to** walk, self care and do activities

Illness B

Problems with: 1. Anxiety
2. Depression
3. Pain

Insurance B Cover %	Insurance B Cost (000)	Guaranteed health state
100	$100	100% cover **No problems** with anxiety, depression and pain
90	$90	
80	$80	
75	$70	75% cover **Slight problems** with anxiety, depression and pain
60	$60	
50	$50	50% cover **Moderate problems** with anxiety, depression and pain
40	$40	
30	$30	
20	$20	25% cover **Severe problems** with anxieties, depression and pain
10	$10	
$0	$0	0% cover **Extreme problems** with anxiety, depression and pain

Question 4:

The cost of a complete cure for illness A remains at $50,000. The cost of insurance guaranteeing a full cure for illness B is **now changed to $150,000.**

In the highlighted boxes, write the amounts you would spend on insurance against illness A and illness B. Please ensure that the two amounts you enter add up to $80,000.

Illness A

Problems with:
1. Walking
2. Self care (washing, dressing)
3. Usual daily activities

Funds left for insurance B	Insurance A Cover %	Insurance A Cost (000)	Guaranteed health state
$30,000	100	$50	← 100% cover **No problems** with walking, self care and activities
$35,000	90	$45	
$40,000	80	$40	← 75% cover **Slight problems** with walking, self care and activities
$45,000	70	$35	
$50,000	60	$30	
$55,000	50	$25	← 50% cover **Moderate problems** with walking, self care and activities
$60,000	40	$20	
$65,000	30	$15	← 25% cover **Severe problems** with walking, self care and activities
$70,000	20	$10	
$75,000	10	$5	
$80,000	$0	$0	← 0% cover **Unable to** walk, self care and do activities

Illness B

Problems with:
1. Anxiety
2. Depression
3. Pain

Insurance B Cover %	Insurance B Cost (000)	Guaranteed health state
100	$150	← 100% cover **No problems** with anxiety, depression and pain
90	$135	
80	$120	← 75% cover **Slight problems** with anxiety, depression and pain
75	$105	
60	$90	
50	$75	← 50% cover **Moderate problems** with anxiety, depression and pain
40	$60	
30	$45	← 25% cover **Severe problems** with anxieties, depression and pain
20	$30	
10	$15	
$0	$0	← 0% cover **Extreme problems** with anxiety, depression and pain

Question 5:

The cost of a complete cure for illness A remains at $50,000. The cost of insurance guaranteeing a full cure for illness B is **now changed to $200,000.**

In the highlighted boxes, write the amounts you would spend on insurance against illness A and illness B. Please ensure that the two amounts you enter add up to $80,000.

Illness A

Problems with: 1. Walking
2. Self care (washing, dressing)
3. Usual daily activities

Funds left for insurance B	Insurance A Cover %	Cost (000)	Guaranteed health state
$30,000	100	$50	100% cover **No problems** with walking, self care and activities
$35,000	90	$45	
$40,000	80	$40	
			75% cover **Slight problems** with walking, self care and activities
$45,000	70	$35	
$50,000	60	$30	
$55,000	50	$25	50% cover **Moderate problems** with walking, self care and activities
$60,000	40	$20	
$65,000	30	$15	
			25% cover **Severe problems** with walking, self care and activities
$70,000	20	$10	
$75,000	10	$5	
$80,000	$0	$0	0% cover **Unable to** walk, self care and do activities

Illness B

Problems with: 1. Anxiety
2. Depression
3. Pain

Insurance B Cover %	Cost (000)	Guaranteed health state
100	$200	100% cover **No problems** with anxiety, depression and pain
90	$180	
80	$160	
		75% cover **Slight problems** with anxiety, depression and pain
75	$140	
60	$120	
50	$100	50% cover **Moderate problems** with anxiety, depression and pain
40	$80	
30	$60	
		25% cover **Severe problems** with anxieties, depression and pain
20	$40	
10	$20	
$0	$0	0% cover **Extreme problems** with anxiety, depression and pain

Question 6: The health states are described a little more fully. Think about your life in the health states described in the 2 scales.

The cost of a **complete cure for illness A is now changed to $40,000**. The cost of insurance guaranteeing a full cure for illness B is **$100,000.**

In the highlighted boxes, write the amounts you would spend on insurance against illness A and illness B. Please ensure that the two amounts you enter add up to $80,000.

Illness A

Problems with: 1. Walking
2. Self care (washing, dressing)
3. Usual daily activities

Funds left for insurance B	Insurance A Cover %	Insurance A Cost (000)	Guaranteed health state
$40,000	100	$40	← 100% cover **No problems** with walking, self care and activities
$44,000	90	$36	
$48,000	80	$32	
$52,000	70	$28	← 75% cover **Slight problems** with walking, self care and activities
$56,000	60	$24	
$60,000	50	$20	← 50% cover **Moderate problems** with walking, self care and activities
$64,000	40	$16	
$68,000	30	$12	
$72,000	20	$8	← 25% cover **Severe problems** with walking, self care and activities
$76,000	10	$4	
$80,000	$0	$0	← 0% cover **Unable to** walk, self care and do activities

Illness B

Problems with: 1. Anxiety
2. Depression
3. Pain

Insurance B Cover %	Insurance B Cost (000)	Guaranteed health state
100	$100	← 100% cover **No problems** with anxiety, depression and pain
90	$90	
80	$80	
75	$70	← 75% cover **Slight problems** with anxiety, depression and pain
60	$60	
50	$50	← 50% cover **Moderate problems** with anxiety, depression and pain
40	$40	
30	$30	
20	$20	← 25% cover **Severe problems** with anxieties, depression and pain
10	$10	
$0	$0	← 0% cover **Extreme problems** with anxiety, depression and pain

Question 7: The health states are described a little more fully. Think about your life in the health states described in the 2 scales.

The cost of a **complete cure for illness A is now changed to $25,000**. The cost of insurance guaranteeing a full cure for illness B is **$100,000.**

In the highlighted boxes, write the amounts you would spend on insurance against illness A and illness B. Please ensure that the two amounts you enter add up to $80,000.

Illness A

Problems with: 1. Walking
2. Self care (washing, dressing)
3. Usual daily activities

Funds left for insurance B	Insurance A Cover %	Cost (000)	Guaranteed health state
$55,000	100	$25	100% cover **No problems** with walking, self care and activities
$57,500	90	$22.5	
$60,000	80	$20	
$62,500	70	$17.5	75% cover **Slight problems** with walking, self care and activities
$65,000	60	$15	
$67,500	50	$12.5	50% cover **Moderate problems** with walking, self care and activities
$70,000	40	$10	
$72,500	30	$7.5	
$75,000	20	$5	25% cover **Severe problems** with walking, self care and activities
$77,500	10	$2.54	
$80,000	$0	$0	0% cover **Unable to** walk, self care and do activities

Illness B

Problems with: 1. Anxiety
2. Depression
3. Pain

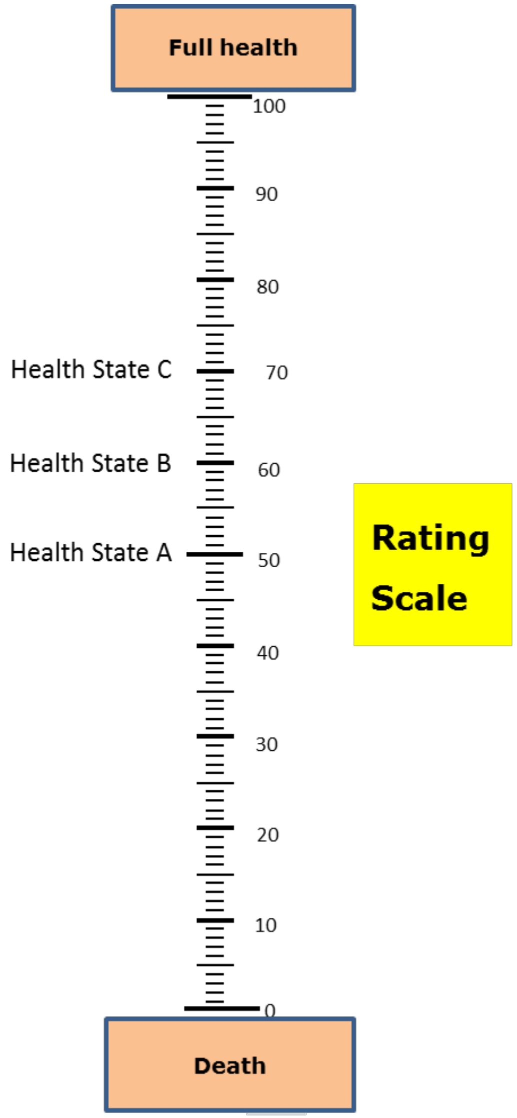
Insurance B Cover %	Cost (000)	Guaranteed health state
100	$100	100% cover **No problems** with anxiety, depression and pain
90	$90	
80	$80	
75	$70	75% cover **Slight problems** with anxiety, depression and pain
60	$60	
50	$50	50% cover **Moderate problems** with anxiety, depression and pain
40	$40	
30	$30	
20	$20	25% cover **Severe problems** with anxieties, depression and pain
10	$10	
$0	$0	0% cover **Extreme problems** with anxiety, depression and pain

Appendix 2 Rating Scale

Introduction to Rating Scale: Now we would like you to evaluate the health states that have been used on a rating scale such as shown. This is a way of measuring how strongly people feel about different things.
On this scale, 0 represents Death and 100 represents Full Health

There are no right or wrong answers and the numbers do not have absolute meaning.
Rather the distance between points shows how strongly you would feel about these health states.

For example if you gave three health states, A, B and C a score of 50, 60 and 70 it would mean that you felt the improvement from A to B was about as much – or as important for you – as a move from B to C.
Similarly a move from death to A (score 50) would be about as important for you as a move from A to full health.



Question 8: On our scale 'Full Health' does not mean perfect health but 'no problems with walking, self care or usual activities: it is good, not perfect health'.

Please indicate using the scale how good or bad these health states are, in your opinion. On this scale, 0 represents Death and 100 represents Full Health.

Write your answers in the highlighted boxes beside each health state.

Health State 1

I have slight problems with
- *Walking about*
- *Washing, dressing*
- *Doing my usual activities*

Health State 2

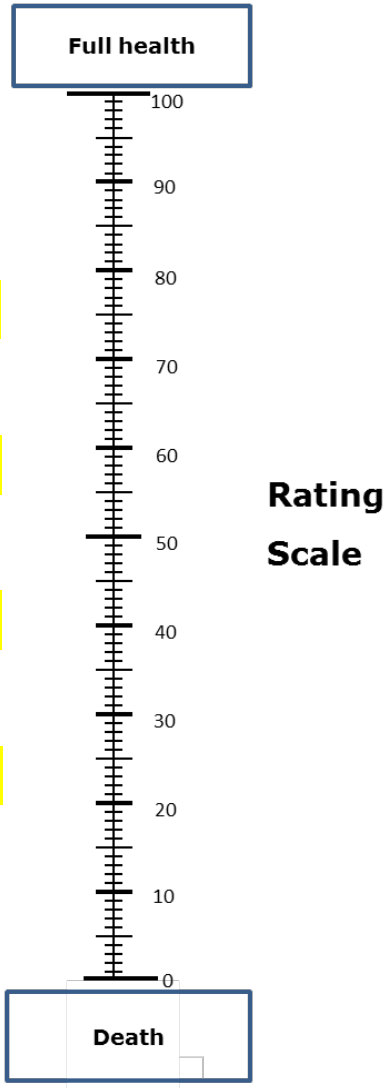
I have moderate problems with
- *Walking about*
- *Washing, dressing*
- *Doing my usual activities*

Health State 3

I have severe problems with
- *Walking about*
- *Washing, dressing*
- *Doing my usual activities*

Health State 4

I am unable to
- *Walk about*
- *Wash, dress myself*
- *Do usual activities*



Question 9: On our scale 'Full Health' does not mean perfect health but 'no problems with anxiety, depression and pain: it is good, not perfect health'.

Please indicate using the scale how good or bad these health states are, in your opinion. On this scale, 0 represents Death and 100 represents Full Health.

Write your answers in the highlighted boxes beside each health state.

Health State 1

I have slight problems with
- *Anxiety*
- *Depression*
- *Pain*

Health State 2

I have moderate problems with
- *Anxiety*
- *Depression*
- *Pain*

Health State 3

I have severe problems with
- *Anxiety*
- *Depression*
- *Pain*

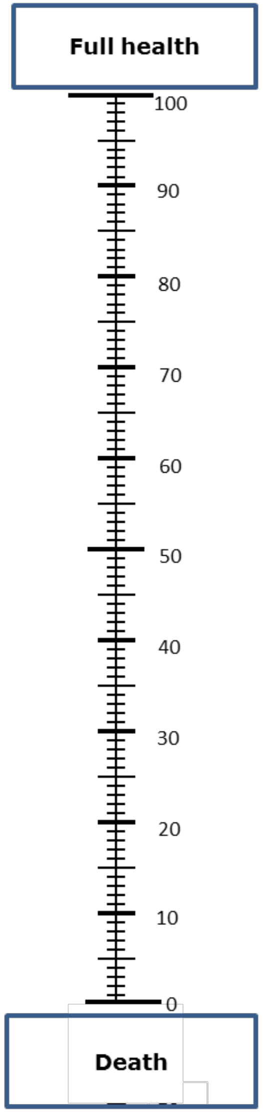
Health State 4

I have severe pain

I have extreme anxiety and depression

Health State 5

I have extreme problems with
- *Anxiety*
- *Depression*
- *Pain*



Rating Scale

Please complete the following questions.

1. First name ....

2. Are you Male or Female?..

3. Year of birth? ....

4. Currently what is the highest level of education you have completed? *(Please check one box)*

Some High School ❐

Completed high school ❐

Apprenticeship/Technical Diploma ❐

University/College ❐

Post Grad ❐

Thank you for your assistance.

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